42 Effects of pre- and postnatal injections of "smoking doses" of nicotine, or vehicle alone, on the maternal behavior and second generation adult behavior of Roman high- and low-avoidance rats

Driscoll,P., Cohen,C., Fackelman,P., Lipp,H.P. and Bättig,K.

Labor für Verhaltensbiologie, ETHZ, Turnerstrasse 1, CH-8092 Zürich, Switzerland; and Anatomisches Institut der Universität Zürich, Winterthurerstrasse 190, CH-8057 Zürich, Switzerland

RHA/Verh and RLA/Verh rats are selected and bred for the rapid versus non-acquisition of two-way, active avoidance behavior, respectively. Based also on other behavioral, neurochemical and hormonal evidence, the RLA/Verh line is considered to be the more anxious of the two. Differences in the sensitivity to nicotine between the two lines have long been recognized in connection with locomotor behavioral tasks. The present studies were intended to expand this knowledge on a practical level, being concerned with the interactional effects of pre- and postnatal nicotine administration and stress on two generations of maternal behavior of females, as well as the adult behavior of males derived from the exposed litters.

Female rats of both lines were either undisturbed (controls), or injected 3-4 times per night with physiological saline (stressor alone) or with 0.3 mg/kg nicotine, i.p., starting 2 weeks before giving birth and continuing until 2 weeks after giving birth. Maternal behavior observations were made during the daytime, using a time-sampling method. Effects of the stressor injections alone were seen almost exclusively in RLA/Verh mothers; e.g. a doubling of their active/passive position ratio, an increase of 50 percent in sleeping while separated from the pups and a 20 percent reduction in time spent in the nest. Remarkably, none of these changes occurred in the rats receiving nicotine injections as compared to control (undisturbed) mothers, indicating that nicotine attenuated the stress response elicited by the injections of vehicle alone. Even more remarkably, when the females derived from these litters matured and bore their own young, the RLA/Verh rats whose mothers had been injected with saline (i.e. the rats which had been indirectly stressed) showed the same changes in maternal behavior that their mothers had shown. Once again, however, these changes were not seen in the maternal behavior of RLA/Verh rats whose mothers had received the nicotine injections.

Studies were also conducted utilizing adult males derived from the first generation litters, and the observation was made that RHA/Verh rats which had been exposed to nicotine in utero and postnatally showed a retarded acquisition of the two-way, active avoidance response, when compared to controls. As associations had been previously suggested to exist between a) a role for the hippocampus and the behavioral effects of nicotine in these rat lines, and b) the extent of the hippocampal infrapyramidal mossy fiber projection and a predisposition to acquire the avoidance response in RHA/-Verh (versus RLA/Verh) rats, the hippocampii of the RHA/Verh rats involved were examined microscopically, using Timm-stain and computer analysis. It was found that pre- and postnatal exposure to nicotine indeed altered the size of the infrapyramidal mossy fiber projection, reducing it to a marginally significant degree. As this change was in the opposite direction to that which would have been expected based on the shuttle box results, however, it was concluded that the behavioral effects of nicotine seen were most likely mediated elsewhere, one possibility being the mesolimbic/nigrostriatal dopaminergic pathways, where profound differences in reactivity have been previously found between RHA/Verh and RLA/Verh rats, reflecting their divergent, inherent locomotor and emotional characteristics.